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Effects of tallow and ground flaxseed on sensory and color characteristics of ribeye steaks

Abstract

Forty-eight ribeye steaks from steers fed diets containing steam-flaked corn (SFC), steam-flaked corn with tallow (SFC/Tallow), or steam-flaked corn with rolled flaxseed (Flax) were used to evaluate the effects of dietary fat on sensory traits, retail display color stability, and fatty acid composition. Steaks from Flax-fed steers had increased deposition of α linolenic acid (C18:3n3, an omega-3 fatty acid; $P<0.01$) and developed a detectable off-flavor ($P<0.05$) when compared to those of cattle fed SFC and SFC/Tallow. There were no differences in tenderness, juiciness, or flavor intensity ($P>0.10$) among the three treatments. Steaks from cattle fed SFC retained a desirable color longer than those from cattle fed Flax ($P<0.05$) which may be attributable to premature lipid oxidation in steaks from cattle fed Flax. This study suggests that altering the fat in the diet may affect flavor and color stability of the meat. Feeding flaxseed can effectively alter composition of carcass tissues to yield beef that is high in omega-3 fatty acids, which may lead to premature lipid oxidation.

Keywords

Cattlemen's Day, 2002; Kansas Agricultural Experiment Station contribution; no. 02-318-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 890; Beef; Flaxseed; Omega-3 fatty acids; α-linolenic acid; Sensory traits

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EFFECTS OF TALLOW AND GROUND FLAXSEED ON SENSORY AND COLOR CHARACTERISTICS OF RIBEYE STEAKS[1]

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Summary

Forty-eight ribeye steaks from steers fed diets containing steam-flaked corn (SFC), steam-flaked corn with tallow (SFC/Tallow), or steam-flaked corn with rolled flaxseed (Flax) were used to evaluate the effects of dietary fat on sensory traits, retail display color stability, and fatty acid composition. Steaks from Flax-fed steers had increased deposition of alpha linolenic acid (C18:3n3, an omega-3 fatty acid; $P<0.01$) and developed a detectable off-flavor ($P<0.05$) when compared to those of cattle fed SFC and SFC/Tallow. There were no differences in tenderness, juiciness, or flavor intensity ($P>0.10$) among the three treatments. Steaks from cattle fed SFC retained a desirable color longer than those from cattle fed Flax ($P<0.05$) which may be attributable to premature lipid oxidation in steaks from cattle fed Flax. This study suggests that altering the fat in the diet may affect flavor and color stability of the meat. Feeding flaxseed can effectively alter composition of carcass tissues to yield beef that is high in omega-3 fatty acids, which may lead to premature lipid oxidation.

(Key Words: Flaxseed, Omega-3 Fatty Acids, Alpha-Linolenic Acid, Sensory Traits.)

Introduction

Flaxseed is a rich source of alpha linolenic acid, an essential omega-3 fatty acid. Notable effects of omega-3 fatty acids include improved immunity, reduced risk of coronary heart disease, and modulation of blood glucose. The estimated daily requirement for omega-3 fatty acids in adult humans is 1 gram. Increasing concentrations of omega-3 fatty acids in beef would provide an alternative means of meeting this requirement. Our objective was to determine if including flaxseed in finishing diets would alter muscle fatty acid composition, and affect retail display life and sensory characteristics of the meat.

Experimental Procedures

Forty-eight steers were housed at the Kansas State Beef Cattle Research Center and fed finishing diets containing steam-flaked corn (SFC), SFC plus 4% tallow, or SFC plus 10% rolled flaxseed (equivalent to 4% added lipids). After slaughter the rib was removed from each carcass and aged in vacuum packages for 21 days at 37°F. One-inch steaks were cut from the posterior end of the rib, and were used for analysis of fatty acid oxidation (TBARS; thiobarbituric acid reactive substances), sensory characteristics, retail display color stability, and fatty acid composition.

Plasma collected from steers 14 days prior to slaughter was analyzed for fatty acids by gas chromatography. Fatty acid content of the longissimus muscle also was determined following extraction of lipids from the muscle tissue. Assessment of

[1]This research was supported by a grant from the North Dakota Oilseed Council.

color change during retail display was determined by L* a* b* values utilizing a HunterLab Miniscan spectrophotometer (Hunter and Associates, Reston, VA). The L* value is a measure of lightness (0 = black to 100 = white), the a* value measures green (-60) to red (60), and the b* value measures blue (-60) to yellow (60). The hue angle measures discoloration from red toward yellow. The reflectance ratio 630 nm/580 nm is a measure of color deterioration, with larger numbers indicating a more desirable red color. The saturation index represents the vividness of the color, with higher numbers indicating a more vivid, less dull color.

Steaks were thawed and cooked to 160°F in a Blodgett modified broiler oven. Cooked steaks were cut into ½ × ½ × 1 inch pieces for evaluation and scored on a scale of 1 to 8 for tenderness, flavor, juiciness, connective tissue content, and flavor intensity, where 8 is desirable and 1 is undesirable. Products were evaluated independently for various flavor and texture attributes by seven panelists.

Results and Discussion

Feeding Flax to cattle increased the proportion of linoleic acid (C18:2) in rib steaks compared to feeding SFC ($P<0.10$; Table 1). Alpha linolenic acid (C18:3n3) also was higher for steaks from cattle fed Flax compared to those from cattle fed SFC or SFC/TALLOW ($P<0.01$). This has potentially important implications for human health because consumption of alpha linolenic acid can decrease cholesterol levels, reduce the risk of cardiovascular disease and stroke, and alleviate inflammation associated with certain forms of arthritis.

Feeding Flax yielded increased plasma levels of alpha linolenic acid ($P<0.05$; Table 2) to 276 μg/ml compared to 13 for SFC and 34 for SFC/Tallow. No difference in C18:3n6 resulted from the diets ($P>0.10$). Steers fed SFC/Tallow had higher plasma content of C16:0 and C16:1 when compared to Flax and SFC ($P<0.05$).

Sensory panel overall tenderness, juiciness, and flavor intensity were not different among treatments (Table 3). However, steaks from steers fed Flax had a more pronounced off-flavor ($P<0.02$). This could be due to incorporation of alpha linolenic acid from the Flax into the muscle, and its subsequent oxidation. Some of the off flavors were described as metallic, rancid, cardboard, sour, and slightly bitter, all suggestive of lipid oxidation.

Instrumental reflectance values for color analysis of rib steak longissimus (L*, a*, and b*) after a 7-day display are presented in Table 4. Lightness (L*) measures were not different among treatments. On day 7, SFC and SFC/Tallow retained the red color better than Flax ($P<0.05$), and steaks from cattle fed SFC had a more vivid color appearance than steaks from cattle fed Flax ($P<0.05$), but were not different than steaks from steers fed SFC/Tallow ($P>0.05$). Retail display life of steaks from cattle fed the Flax diet was shorter than that of steaks from cattle SFC and SFC/Tallow, as evidenced by changes in the 630/580 nm ratio.

Feeding Flax to finishing cattle increases omega-3 fatty acids in muscle and may have application for producing value added beef products. However, supplementation with antioxidants, such as vitamin E, may be necessary to prevent premature lipid oxidation and to promote longer retail display life.

Table 1. Long Chain Fatty Acids in Ribeye Steaks

	SFC[e]	SFC/Tallow	FLAX	SEM
C14:0	4.6	4.6	5.0	.54
C14:1	1.1	1.2	1.2	.18
C15:0	.7	.7	.8	.10
C15:1	1.1	1.3	1.5	.25
C16:0	33.4	25.5	30.4	3.62
C16:1	2.9	4.9	3.6	.65
C17:0	1.2	1.8	1.3	.19
C17:1	1.4	1.3	0.8	.18
C18:0	7.4	11.3	10.2	1.32
C18:1	37.9	38.0	32.3	4.25
C18:2	6.3[a]	6.6[ab]	8.4[b]	.86
C18:3	0.2[c]	0.2[c]	2.1[d]	.12

[1]Values expressed as a percent of fat content.
[a,b]Means in a row with unlike superscripts are different ($P<0.10$).
[c,d]Means in a row with unlike superscripts are different ($P<0.01$).
[e]Steam-flaked corn.

Table 2. Long Chain Fatty Acids in Plasma[1]

	SFC[e]	SFC/Tallow	FLAX	SEM
C14:0	16.9	17.8	11.7	2.97
C14:1	1.7[cd]	2.5[c]	0.0[d]	1.00
C15:0	13.7[cd]	14.0[c]	9.4[d]	1.88
C15:1	1.9[d]	7.9[cd]	10.3[c]	3.10
C16:0	185.4[a]	257.5[b]	198.8[a]	14.26
C16:1	2.8[a]	20.0[b]	5.5[a]	2.40
C17:1	11.6	14.5	7.2	2.83
C18:0	1466.6	1406.1	908.0	409.97
C18:1n9	256.4	94.3	248.6	96.23
C18:1n9c	217.0	200.2	120.1	43.52
C18:2	1212.2	1287.4	1317.7	102.40
C18:3n6	13.7	20.4	7.4	3.18
C18:3n3	12.9[a]	33.8[a]	275.6[b]	19.20

[1]Values expressed as μg fatty acid/mL plasma.
[a,b]Means in a row with unlike superscripts are different ($P<0.05$).
[c,d]Means in a row with unlike superscripts are different ($P<0.10$).
[e]Steam-flaked corn.

Table 3. Sensory Panel Evaluation of Ribeye Steak Longissimus Muscle from Cattle Fed Diets Containing SFC, SFC/Tallow, and Flax

	Diets			
Item	SFC[e]	SFC/Tallow	Flax	SEM
Myofibrillar tenderness	6.58	6.59	6.55	.122
Juiciness	6.11	5.82	5.78	.271
Flavor intensity	5.81	5.96	5.94	.076
Connective tissue amount	7.36	7.39	7.25	.094
Overall tenderness	6.70	6.73	6.65	.120
Off flavor intensity	7.69[a]	7.64[a]	7.36[b]	.083
TBARS[c]	.10[a]	.09[a]	.16[b]	.021

[a,b]Means within same row without common superscripts differ (P<0.02).
[c]Thiobarbituric acid ractive substances, expressed as mg of malonaldehyde/1000 grams of longissimus muscle.
[e]Steam-flaked corn.

Table 4. Color Profiles on Day 7 of Display for Longissimus Steaks from Cattle Fed SFC, SFC/Tallow, or Flax

	Diets			
Item	SFC[c]	SFC/Tallow	Flax	SEM
L*	45.2	44.2	45.1	.59
A*	26.6[a]	25.6[ab]	22.9[b]	.91
B*	20.9	20.6	19.6	.50
Hue Angle	38.3[a]	38.9[a]	41.0[b]	.61
Saturation Index	33.9[a]	32.8[ab]	30.2[b]	1.00
630/580	4.1[a]	3.9[ab]	3.3[b]	.21

[a,b]Means within same row without common superscripts differ (P<0.05).
[c]Steam-flaked corn.